



MOJZA

5070

O Levels

CHEMISTRY

GUIDE TO STOICHIOMETRY QUESTIONS



UPDATED TO THE
2025-27 SYLLABUS

1st
Edition

MOJZA

O Levels

A Guide To Stoichiometry Questions

5070



BY TEAM MOJZA

The Mole

→ Mole is the amount of substance in 6.02×10^{23} number of particles.

Finding out Moles

Mole = $\frac{\text{Number of particles}}{6.02 \times 10^{23}}$
Mole = $\frac{\text{Mass in grams}}{\text{Molecular mass}}$
Mole (at r.t.p) = $\frac{\text{Volume of gas in dm}^3}{24}$
Mole = Concentration $\times$ Volume

Empirical Formula

→ It is the simplest whole number ratio of the different atoms or ions in a compound.

Steps to find Empirical Formula

1) Find the mass of the atom/element (in grams)
2) Find the molecular mass of the atom/element
3) Find moles (moles = Mass/Molecular mass)
4) Divide the number of moles of each element by the smallest number of moles calculated in the previous step. This will give you a ratio.
5) If the ratios are not whole numbers , then multiply the ratios with the same factor to obtain whole numbers.
6) Use the whole number ratios as subscripts for each element in the formula to write the empirical formula.

Molecular Formula

→ It is a formula that shows the actual number of atoms in a molecule.

Steps to find molecular formula using the empirical formula

1) Calculate the mass of the empirical formula.
2) Determine the molecular mass of the compound.
3) Divide the molecular mass of the compound by the mass of the empirical formula. This gives you a ratio (n).
4) Multiply each subscript in the empirical formula by the ratio (n) to get the molecular formula.

Percentage by mass of an element in a compound

Formula to find percentage by mass of an element in a compound

1) $\frac{\text{Number of atoms of the element in the formula} \times \text{Atomic mass of the element}}{\text{Molecular mass of the compound}}$
2) Multiply by 100%

Percentage yield

→ It shows the relationship between actual yield and theoretical yield.

Yield

→ It is the amount of product formed in a reaction.

Theoretical yield

→ It is the calculated amount of the product that would be obtained if the reaction were to be complete.

Actual yield

→ It is the amount of pure product that is actually produced in the experiment.

→ Know that: Actual yield < Theoretical yield

1) $\frac{\text{Actual yield}}{\text{Theoretical yield}}$
2) Multiply by 100%

Percentage purity

1) $\frac{\text{Mass of pure substance in sample}}{\text{Mass of sample}}$
2) Multiply by 100%

Limiting Reactant

→ It is the reactant that is completely used up in a chemical reaction and determines the amount of product that can be formed.

How to identify limiting reactant

1) Balance the chemical equation
2) Find moles of the reactants (Mass/Molecular mass)
3) For each reactant, divide the moles you have calculated in the previous step by its coefficient in the balanced equation. This gives you a ratio.
4) The smallest ratio will be your Limiting reactant.

Challenging past paper questions with their explanations

Reference:

S23_qp_22_Q9

Question:

A sample of clean, dry air contains 0.0400% carbon dioxide by volume. Calculate the number of molecules of carbon dioxide in 480dm^3 of clean, dry air at room temperature and pressure. One mole of any gas contains 6.02×10^{23} molecules.

Explanation:

→ Firstly, we will calculate the volume of CO_2 in air:

$$0.0400 \times 480$$

$$100$$

$$= 0.192\text{dm}^3$$

→ Then, find moles of CO_2 using formula:

$$\text{Volume in dm}^3 / 24$$

$$\text{So, } 0.192/24 = 0.008 \text{ (or } 8 \times 10^{-3}\text{)}$$

→ Now, we have moles of CO_2 and need to find the number of molecules. This can be calculated using the formula:

$$\text{Moles} = (\text{Number of molecules}) / (6.02 \times 10^{23}).$$

$$\text{So, } 0.008 \times (6.02 \times 10^{23}) = \text{Number of molecules}$$

→ Number of molecules, therefore, equals to **4.816×10^{21}**

Examiner remarks:

Candidates found this question challenging and often missed out at least one of the steps of the calculation. The best answers gave working out that involved calculating the moles of carbon dioxide using the molar gas volume, using the data about 0.0400% carbon dioxide by volume and finally, multiplying the amount in moles by the Avogadro constant. Candidates often only did one or two of these steps in their calculations. Although many candidates appreciated that somewhere in the calculation they had to multiply by the Avogadro constant, some did not show sufficient working out to be credited with error carried forward marks.

Reference:

W21_qp_22_Q4

Question:

A hydrocarbon contains 88.9% carbon by mass. Calculate the empirical formula of this compound.

Explanation:

- We need to calculate moles. As mass of carbon is given, we will use the formula:
Moles = Mass / Molecular mass
- If the hydrocarbons contain 88.9% of carbon, so from calculations (100-88.9=11.1) hydrogen has mass of 11.1%.
- We will calculate moles of hydrogen and carbon separately using the above mentioned formula.

Moles of Hydrogen: $11.1/1 = 11.1$
Moles of Carbon: $88.9/12 = 7.41$
- According to the method of calculating empirical formula, we have to divide these moles by the smallest one, which in this case is moles of hydrogen: 11.1
- So, for hydrogen we get 1 and for carbon we get 0.682. This is a ratio.
- We need these ratios in whole numbers. As the Carbon ratio is not a whole number, we'll have to multiply both ratios with the same factor to obtain whole number ratios for both elements.
- In this case, the factor is 3 as multiplying it with 1 gives us 3 and multiplying it with 0.682 gives us 2.04 (it can be rounded off to 2 as it's super close).
- Therefore, for Carbon we get 2 and for hydrogen we get 3.
- We will use these numbers as subscripts for each element to write the empirical formula
- So, it will be **C₂H₃**

Examiner remarks:

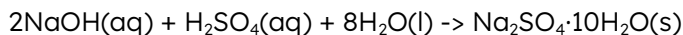
Many candidates knew the initial step in the calculation of the empirical formula but rounded the figures for the ratio of carbon to hydrogen to give CH₂ rather than C₂H₃

Reference:

W11_qp_21_Q6

Question:

The student uses 25.0cm³ of 1.60 mol/dm³ sodium hydroxide to prepare the crystals.



Calculate the maximum mass of hydrated sodium sulphate crystals that can be formed.

Explanation:

- We have been given volume and concentration of NaOH, so we can calculate it's moles using the formula: moles = concentration × volume.
 - As concentration is given in mol/dm³, we have to make sure that the volume is also in dm³.
 - So to convert cm³ to dm³ we divide by 1000. Therefore the volume would be 25÷1000 = 0.025dm³
 - Our moles of NaOH would be 0.025 × 1.60 = 0.04 mol
 - We will now determine the moles of hydrated sodium sulphate from the given equation. We know that 2 moles of NaOH produce 1 mole of hydrated sodium sulphate crystals (look at the coefficients). We will simply cross multiply to see how many moles we can actually obtain.
- $$\begin{aligned}
 2 &= 0.04 \text{ (NaOH)} \\
 1 &= x \text{ (Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O)} \\
 2x &= 0.04 \\
 x &= 0.04 \div 2 \\
 x &= 0.02
 \end{aligned}$$
- So, the moles of hydrated sodium sulphate are 0.02 moles.
 - As we have now obtained moles of hydrated sodium sulphate, we need its Molecular mass. We can calculate it by the help of a periodic table. It is 322.
 - We'll now simply put it into the formula:

$$\begin{aligned}
 \text{Moles} &= \text{Mass in grams} / \text{Molecular mass} \\
 0.02 &= \text{Mass in grams} / 322 \\
 0.02 \times 322 & \\
 \text{Mass} &= \mathbf{6.44g}
 \end{aligned}$$

Examiner remarks:

Only a very small proportion of candidates were able to calculate that the mass of sodium sulfate crystals would be 6.44g. Good answers were clearly laid out in a logical fashion. Many candidates were not able to calculate the relative formula mass of hydrated sodium sulfate and others did not use the volume and concentration of sodium hydroxide to determine the amount in moles of sodium hydroxide.

Reference:

W22_qp_22_Q9

Question:

Magnesium carbonate reacts with dilute hydrochloric acid.



When 25.0cm³ of dilute hydrochloric acid is added to excess magnesium carbonate, the volume of carbon dioxide gas produced at room temperature and pressure is 120cm³. Calculate the concentration, in mol/dm³, of the dilute hydrochloric acid.

Explanation:

- We will calculate the moles of Carbon dioxide using the formula:
Moles = Volume of gas in dm³/24
- When volume is given in cm³, we just simply divide it by 24000 instead of 24. This simplifies the calculation based on the unit we have.
- So, we will use the following formula:
Moles = Volume of gas in cm³/24000
Moles = 120 cm³/24000
Moles of Carbon dioxide = 0.005
- From the equation in the question we can see that 1 mole of Carbon dioxide requires 2 moles of HCl (see the coefficient). We will simply use cross multiplying to obtain the actual moles of HCl.

1 = 0.005 (Carbon dioxide)
2 = x (HCl)
x = 0.01 mol
Therefore, actual moles of HCl are 0.01 mol.
- Now we will simply use the formula:
Moles = concentration × volume to find the concentration of hydrochloric acid.
- Note that the volume of HCl in cm³ has been given to us in the question but we have to find concentration in mol/dm³. For this, we have to convert volume in cm³ to volume in dm³. We simply divide by 1000.

Volume in dm³ = 25÷1000
= 0.025 dm³
So, Moles = concentration × volume
0.01 = concentration × 0.025
0.01÷0.025 = concentration
Concentration of HCl = **0.4 mol/dm³**

Examiner remarks:

Many of the answers were poorly constructed and did not clearly show the working out. This often made it difficult to award error carried forward marks for later working out following an initial mistake. The best answers calculated the moles of carbon dioxide using the molar gas volume, then used the stoichiometric relationship in the equation to calculate the moles of HCl.

Finally, the concentration of HCl was worked out. Many candidates used the incorrect volumes in their calculation using the volume of acid and the molar gas value.

Additional Tips for Moles/Stoichiometry

1. Understand all the concepts thoroughly:

Familiarise yourself with all the contents of the topic by referring to the official Cambridge syllabus. Ensure your thorough understanding of the concepts and then practise adequate questions to reinforce your understanding.

2. Step-by-step Calculations:

Never skip any steps while calculating as this minimises the chance of errors and ensures accuracy.

3. Notice the units:

Always pay special attention to unit conversions. Most of the time, volumes are provided in cm^3 , which needs to be converted into dm^3 . Either divide the volume in cm^3 by 1000 to obtain volume in dm^3 or use the following formula:

$$\text{Moles} = \frac{\text{Volume of gas in cm}^3}{24000}$$

If you have to find concentration or have to use that and your volume is in cm^3 , ensure to divide it by 1000 to obtain volume in dm^3 before doing further calculations.

4. Utilise Mole ratios:

Use the coefficients in the balanced chemical equation to set up mole ratios between the reactants and the products.

5. Quick revision guide:

For efficient revision, refer to this guide. Afterwards, practise a few questions to ensure active recalling.

6. Practise, Practise, Practise

The Stoichiometry section of the Chemistry syllabus demands a lot of past paper practice. Throughout the years, various sorts of questions have been assessed. Thoroughly doing these will equip a more faster and efficient approach when a new question is presented.

7. Formulas

Make sure that you have all the respective formulas, and their possible derivative formulas in the back of your mind before doing a question.

8. Always Read the Question Carefully

Always carefully read the question when solving stoichiometric questions as these may include much helpful information. Plus, the question may also instruct regarding the wanted nature of answer (ie. decimal places, cm^3/dm^3 etc.)



A Note from Mojza

These notes for Chemistry(5070) have been prepared by Team Mojza, covering the content for GCE O Level 2025-27 syllabus. The content of these notes has been prepared with utmost care. We apologise for any issues overlooked; factual, grammatical or otherwise. We hope that you benefit from these and find them useful towards achieving your goals for your Cambridge examinations.

If you find any issues within these notes or have any feedback, please contact us at support@mojza.org.

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These notes are made to encompass the complete syllabus for 5070 from 2025 to 2027, with great attention and care for every topic. All information is curated in a simple, clear, and concise manner. The aim is to aid students and make learning easier in preparation for their exams. Team Mojza makes every effort to error-check all the content; if you find any discrepancies, please reach out to us at support@mojza.org.